Arctic Network
Bering Land Bridge N Pres. • Cape Krusenstern NM
Gates of the Arctic NP & Pres. • Kobuk Valley NP • Noatak N Pres.

Shallow Lakes Resource Brief

November 2010, no. 12

In the Arctic most of the lakes are formed when permafrost melts and forms a small depression where water accumulates, called a thermokarst. Hundreds of small thermokarst ponds are found in the lowland areas of Kobuk Valley National Park.

Status & Trends

Understanding lake drainage in northern Alaska's national parks

In 2007, ARCN initiated its shallow lake monitoring project. To date, the network has installed permanent monitoring sites at 15 lakes in Bering Land Bridge National Preserve (BELA) and 30 lakes in Kobuk Valley National Park (KOVA). At each site the network has collected data on water chemistry, vegetation composition, macroinvertebrate composition, lake level and seasonal thaw depths. In addition to monitoring these vital signs, the project collects a diverse array of aerial photographs and satellite images of lakes and other landscape features. Although the shallow lake monitoring project is in its infancy in the Arctic Network, our investigations have already revealed a landscape that appears to be changing.

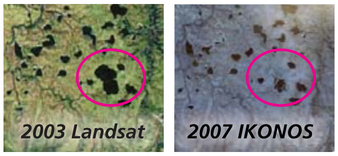

Figure 2: *Remote sensing is used to track historical changes in lake surface area. These photographs show changes in lake surface area of the large lake across 4 years.*

Researchers working in this region have found that lake surface area has declined by 14-20% in KOVA (Figure 1) . Concurrent to these discoveries, our evaluation of aerial photographs identified 12 lakes in KOVA that have drained catastrophically over the past 10 years (Figure 2). These discoveries piqued the interest of park staff, who initiated an in-depth investigation into the mechanisms of lake drainage in this region.

In 2010, park staff and collaborators (ABR Inc.) surveyed 20 drained lakes in KOVA. Preliminary findings indicate that most lakes had been drained as a result of permafrost degradation at the outlet channel, except in dune lakes, where drainage had either occurred out the bottom of the lake or the lake had evaporated. Data analysis on this project will continue through 2011 at which time the network will have a lake vulnerability model to use to make important management decisions. Implementation of the shallow lake monitoring protocols will continue in 2011 in KOVA.

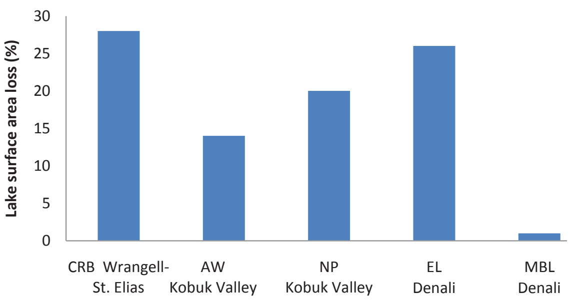

Figure 1: *Loss in lake surface area over the past 30–50 years in national parks located across north-central Alaska. CRB = Copper River Basin, AW= Ahnewetut Wetlands, NP= Nigeruk Plain, EL= Eolian Lowlands, MBL= Minchumina Basin Lowlands. Source: M. Necsoiu et al. 2009; Riordan et al. 2006; Verbyla 2007.*

Objectives

What do we want to know about shallow lakes in the Arctic Network?

- Long term trends in the area, distribution, and number of shallow lakes and ponds
- Decadal-scale trends in the water chemistry of shallow lakes and ponds
- Long term trends in the structure and composition of littoral vegetation
- Long term trends in macro-invertebrate taxa richness

Shallow lakes are being monitored in 3 of 5 Arctic Network parks:

Importance

Why are shallow lakes important in the Arctic Network?

Tens of thousands of shallow lakes are distributed across the Arctic Network. Although small, these ecosystems serve a diverse array of ecological functions ranging from flood protection, groundwater recharge, and water purification to providing prime habitat to moose, waterfowl and furbearers. Because they are so productive and diverse, shallow lakes are important to the people who hunt and trap within the park boundaries. They are also important indicators of the health and integrity of the natural environment. Many scientists believe that shallow lakes are disappearing throughout arctic and subarctic regions. Loss of these important habitats will have important effects on water quality, water storage and wildlife habitat.

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Management Applications

How can monitoring shallow lakes help protect parks in ARCN?

- Identify areas of the parks that are undergoing landscape scale change
- Help us understand how plants and animals respond to lake dynamics
- Help us understand how changes in lake ecosystems are related to other important vital signs such as climate, caribou and furbearers

Long-term Monitoring:

How will we monitor shallow lakes in the Arctic Network?

We are using a two-pronged approach that combines remote sensing with field surveys to monitor shallow lake ecosystems. We use remotely sensed imagery to detect changes in the area, distribution and number of shallow lakes and ponds. We use field survey techniques to monitor water chemistry, vegetation, and macroinvertebrate richness. Because there is not a good understanding of lake ecosystem dynamics in this region, it is essential that we use a sampling design that allows us to understand both spatial and temporal aspects of lake dynamics. To accomplish this we have developed a three tiered approach: tier one lakes are continuously monitored, tier two lakes are monitored multiple times per season, and tier three lakes are monitored once per open water season. This approach allows us to capture both the spatial and seasonal dynamics of lakes while still allowing us to sample a relatively large number of lakes distributed across the Arctic network.

Vegetation transects are used along the littoral zone (lake shore) to measure percent cover, frequency and species composition.

ARCTIC NETWORK

USING SCIENCE TO PROTECT OUR PARKS

THE ARCTIC NETWORK (ARCN) IS A MAJOR COMPONENT OF THE NATIONAL PARK SERVICE'S STRATEGY TO BETTER UNDERSTAND AND MANAGE PARK LANDS USING SCIENTIFIC INFORMATION. IT IS ONE OF FOUR INVENTORY AND MONITORING NETWORKS IN ALASKA AND 32 NATIONWIDE.

The Arctic Network provides scientific support to five parks covering more than 19 million acres. Bering Land Bridge National Preserve and Cape Krusenstern National Monument share similar coastal resources and biogeographic ties to the former land bridge between North America and Asia. Kobuk Valley National Park, Noatak National Preserve and Gates of the Arctic National Park and Preserve span extensive, mountainous terrain at the northern limit of treeline.

The Arctic Network is developing long-term monitoring protocols for 28 'vital signs', or physical, chemical and biological indicators that were selected to represent the overall health of these parklands. Many of these vital signs are expected to show change due to regional and global stressors including climate change and deposition of industrial contaminants. Many vital signs also have important human values including for subsistence.

ARCN VITAL SIGNS:

- Air Contaminants
- Brown Bears
- Caribou
- Climate
- Coastal Erosion
- Dall's Sheep
- Fire Extent & Severity
- Fish Assemblages
- Invasive/Exotic Diseases
- Invasive/Exotic Species
- Lagoon Communities & Ecosystems
- Lake Communities & Ecosystems
- Landbird Monitoring
- Moose
- Muskox
- Permafrost
- Point Source Human Effects
- Sea Ice
- Small Mammal Assemblages
- Snow & Ice
- Stream Communities & Ecosystems
- Subsistence/Harvest
- Surface Water Dynamics & Distribution
- Terrestrial Landscape Patterns & Dynamics
- Terrestrial Vegetation & Soils
- Visitor Use
- Western Yellow-billed Loons
- Wet & Dry Deposition

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